REMARKS

Applicants have amended their claims in order to further clarify the definition of the present invention. Specifically, Applicants have canceled claim 9 without prejudice or disclaimer, and have substituted therefor new claim 27. Claim 27 sets forth the subject matter of claim 9 in independent form. Noting the objection to claim 9 as set forth on page 8 of the Office Action mailed February 24, 2003, it is respectfully submitted that claim 27 should be allowed.

Applicants have amended claim 1 to recite that the friction stir welding method includes conducting friction stir welding of at least first and second members, with the first and second members forming a joint line, the friction stir welding being performed using a rotary tool along the joint line; to recite that the rotary tool is retreated from the first and second members being welded, so that the rotary tool is withdrawn from the joint line; and to recite that the rotary tool is moved along the joint line in the changed direction of the joint line. Claim 2 has been amended to clarify that it is the direction of the rotary tool that is changed by retreating the tool and then rotating a device that supports the rotary tool; and claim 7 has been amended to recite that, "after reinsertion", the insertion depth is gradually reduced after starting the movement of the rotary tool.

In addition to claim 27, new claims 16-26 have been added to the application. Claim 16, dependent on claim 1, recites that the direction of the joint line changes from a first direction to a second direction, with the second direction being orthogonal to the first direction; and claims 17 and 18, dependent respectively on claims 16 and 1, respectively recites that the first and second directions are straight lines, and recites that at least one of the first and second directions is a straight line.

Claims 19 and 20, dependent respectively on claims 1 and 19, respectively recites that one of the at least first and second members has a projection along the joint line, extending toward the rotary tool, and another of the at least first and second members, forming the joint line, does not have the projection, and wherein a fillet weld is provided on the another of the at least first and second members at the joint line between the one and the another of the at least first and second members; and recites that the fillet weld has a height and width substantially the same as a height and width of the projection. Claims 21 and 22, dependent respectively on claims 8 and 21, respectively recites that the rotation of the rotary tool is continued during the retreating, while movement of the rotary tool along the joint line is stopped during the retreating; and recites that the rotary tool is tilted during the retreating. Claims 23 and 24, each dependent on claim 1, respectively recites that the rotary tool is rotated during the reinserting at the position where the rotary tool was retreated, and recites that during the retreating, a hole is left at the position where the rotary tool was retreated, the rotary tool being inserted into this hole in the reinserting; and claim 25, also dependent on claim 1, recites that the conducting of the friction stir welding is performed prior to the retreating, and is performed to the position where the direction of the joint line changes. Claim 26, dependent on claim 1, recites that the joint line extends continuously through the position where the direction of the joint line changes.

In connection with amendments to previously considered claims, and also in connection with the newly added claims, note, for example, pages 12-19 of Applicants' specification, particularly together with Figs. 1-4 of Applicants' disclosure.

The election-of-species requirement set forth on pages 2 and 3 of the Office

Action mailed February 24, 2003, is noted. Applicants affirm their election of Species I. In addition to claims 1-9 (now claims 1-8 and 27), it is respectfully submitted that new claims 16-26 also read on the elected species. Claims 10-15 are being maintained in the application, subject to the filing of a Divisional application or applications directed to the subject matter thereof in due course if the election-of-species requirement is maintained.

Of the non-elected claims, Applicants respectfully direct attention to claims 12-15. Compare with newly added claims 19 and 20. It is respectfully submitted that it would not constitute an undue burden to rejoin claims 12-15 in the above-identified application. Accordingly, reconsideration and withdrawal of the election-of-species requirement, insofar as applicable to Species I and III, and examination of all of the Species I and III claims in the present application, are respectfully requested.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner on the merits in the above-identified application patentably distinguish over the teachings of the references applied by the Examiner in the Office Action mailed February 24, 2003, that is, the teachings of the U.S. patents to Ezumi, et al., No. 6,273,323, and to Thomas, et al., No. 5,460,317, and "Koga et al (JP 2000 135577 A)", under the provisions of 35 USC 102 and 35 USC 103.

Initially, attention is respectfully directed to the applied reference designated by the Examiner as "Koga et al (JP2000 135577 A)". However, it is to be noted that two Koga, et al. references have been cited, that is, 2000-135575 and 2000-135576; no Koga, et al. reference designated by the number 2000-135577 has been cited. If

the prior art rejection using Koga, et al. is maintained, it is respectfully requested that the Examiner properly identify the Koga, et al. reference being applied. To facilitate proceedings, both JP 2000-135575 and JP 2000-135576 are addressed herein.

In any event, it is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such a friction stir welding method as in the present claims, wherein friction stir welding is conducted along a joint line (between at least first and second members) having a change of direction therealong, the method including steps of retreating the rotary tool performing the friction stir welding from the at least first and second members being welded when the rotary tool reaches a position where the direction of the joint line changes, so that the rotary tool is withdrawn from the joint line; changing the direction of the rotary tool or the members being welded; reinserting the rotary tool substantially at the position where the rotary tool was retreated; and moving the rotary tool along the joint line in the changed direction of the joint line. See claim 1.

It is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested the additional features of the present invention as recited in the dependent claims, having the processing steps as discussed previously in connection with claim 1, and further including (but not limited to) the additional features wherein the direction of the rotary tool is changed by retreating the tool and then rotating a device that supports the rotary tool, thereby varying the tilt angle of the rotary tool against the direction of movement thereof (see claim 2); and/or wherein the tilt angle of the rotary tool is varied with the retreating position set as a reference (see claim 3); and/or wherein the tilt angle of the rotary tool is varied with the tip of the rotary tool set as a reference (see claim 4); and/or

the features set forth in claims 5-7, of changing the depth of the rotary tool at the time of reinsertion or prior to retreating; and/or wherein the retreating of the rotary tool is performed after stopping the movement thereof (see claim 8), specifically wherein rotation of the rotary tool is continued during the retreating while movement of the rotary tool along the joint line is stopped (see claim 21); and/or wherein one of the members being friction stir welded has a projection along the joint line while another does not, with a fillet weld being provided on the other member at the joint line between these two members (see claim 19), particularly wherein this fillet weld has a height and width substantially the same as a height and width of the projection (see claim 20); and/or wherein the direction of the joint line changes from a first direction to a second direction, the second direction being orthogonal to the first direction (see claim 16), particularly wherein at least one of the first and second directions are straight lines (see claim 17; note also claim 18); and/or wherein rotation of the rotary tool is continued during the retreating, while movement of the rotary tool along the joint line is stopped (see claim 21), particularly wherein the rotary tool is tilted during the retreating (see claim 22); and/or wherein the rotary tool is rotated during the reinserting at the position where the rotary tool was retreated (see claim 23); and/or wherein during the retreating a hole is left at the position where the rotary tool was retreated, and wherein in the reinserting the rotary tool is inserted into the hole (see claim 24); and/or wherein the friction stir welding is performed prior to the retreating, and is conducted to the position where the direction of the joint line changes (see claim 25); and/or wherein the joint line extends continuously through the position where the joint line changes position (see claim 26).

The present invention relates to a friction stir welding method. According to one technique for friction stir welding, projections protruding to the side from which the rotary tool is inserted are formed to the two abutting members to be welded, and friction stir welding is performed by inserting a small-diameter portion of the rotary tool to the abutted portions, and inserting the large-diameter portion of the rotary tool to the projections. The metal material constituting the projections is used as a source material to fill any gap between the two abutted members. The projection can be formed only to one of the two members to be welded, and such method having the projection at only one of the two members is used to friction stir weld extruded members where the extruded direction of one member is orthogonal to that of the other member. Note the paragraph bridging pages 1 and 2 of Applicants' specification.

However, since only one of the two abutting members has a projection, there may be insufficient additional material to fill gaps between the two abutting members, and defects could likely occur. For example, since a car body and rim member at an entrance to the car body are formed of extruded members, and since the direction of extrusion of one is orthogonal to the other, a projection serving as the source material for filling the gap existing at the abutted portion can only be provided to abutting portions of one of these members to be welded; and, as a result, defects are likely to occur.

When performing friction stir welding to provide a car body or the like having windows, it has been proposed to utilize a plural number of rotary tools to one traveling body for the welding process. The traveling body is stopped just before the window portion, and all of the rotary tools are retreated from the welded members,

before reinserting the rotary tools that do not intercept the window portion. The movement of the traveling body is then restarted, and friction stir welding is continued.

In friction stir welding, the rotary tool is tilted (that is, direction of the rotary tool is tilted) along the direction of movement of the rotary tool. However, a problem arises when the direction of movement of the rotary tool changes; at such time, direction of the rotary tool (e.g., tilt thereof) must be changed. When varying the direction of the rotary tool, translational movement of the tool must be stopped. That is, translational movement of the rotary tool is stopped, but the rotation thereof is continued, with the tool inserted to the joint of the members being welded. This causes defects to occur at the joint of the friction stir weld. See the first paragraph on page 4 of Applicants' specification. Note also the second paragraph on page 4 thereof.

Against this background, Applicants provide a friction stir welding method wherein such defects are avoided, even where the direction of the joint line changes. Applicants have found that the foregoing problems can be avoided by the method according to the present invention, wherein the rotary tool is retreated (withdrawn) from the joint line when the rotary tool reaches a position where the direction of the joint line changes, the direction of the rotary tool (for example, tilt thereof) is changed, and the rotary tool is reinserted substantially at the position where the tool was withdrawn. Through use of this process, a defect at the location, for example, where the joint line changes direction, can be avoided. That is, by returning the tool to the same position after, for example, changing the tilt of the rotary tool, defects due to stopping the motion of the rotary tool can be avoided. Note, for example, the

first and second full paragraphs on page 18 of Applicants' specification.

In addition, by using the fillet weld as in various of the present claims, sufficient material can be provided, while having a projection on only one of the abutting members forming the joint line, to avoid defects due to a lack of material for filling gaps between the two abutted members. See the last full paragraph on page 12, and first full paragraph on page 13, of Applicants' specification.

Koga, et al. No. 2000-135576 discloses a friction joining device capable of joining a hollow member at low cost and high efficiency. A joining force support mechanism 10 slidably contacting with a back face of a joint part 22 is installed, and jointing is performed while the jointing force support mechanism 10 is relatively moved against a jointed member P together with a jointing tool T.

Koga, et al. No. 2000-135575 discloses a jointing operation of a jointed member by mounting a jointing tool to a rotor which can be rotated around an axial core perpendicular to a jointing part surface of a jointed member and fixed to a specific rotation position under an inclined position, wherein a tool supporting member 25 is fixed to a rotor 24 while it is inclined against its axial core by a given angle.

Whichever of No. 2000-135575 or No. 2000-135576 is being applied by the Examiner, it is respectfully submitted that neither of these two references would have disclosed or would have suggested such a friction stir welding method as in the present claims, including the conducting of the friction stir welding using a rotary tool, along a joint line between at least first and second members, with the rotary tool retreating (being withdrawn) from the members being welded when the rotary tool (moving along the joint line) reaches a position where the direction of the joint line

changes; and changing the direction of the rotary tool or the members being welded, and reinserting the rotary tool at the position where the rotary tool was retreated, with the rotary tool moving along the joint line in the changed direction of the joint line, or the other aspects of the present invention as discussed previously.

It is respectfully submitted that in neither of the two Koga, et al. references is the rotary tool reinserted at the position where it was withdrawn, much less the other aspects of the present invention as in the present claims.

It is respectfully submitted that in, for example, Figs. 3 and 5 of No. 2000-135575, the joint lines are not continuous, and clearly any reinsertion of the rotary tool is at a location spaced from where the rotary tool was retreated. It is respectfully submitted that, for example, No. 2000-135575 would have neither taught nor would have suggested the specific problems addressed according to the present invention, occurring where there is a change in the direction that a joint line between two members extends, or solutions thereto, achieved by the present invention.

Moreover, according to, for example, No. 2000-135575, where the rotary tool is not reinserted to the members to be welded at about the same position as where the tool was retreated, weld defects may be generated at the portion where the rotary tool is reinserted (that is, the different joint line between different members). Clearly, No. 2000-135575 would have neither taught nor would have suggested the specific problems, solutions thereto and advantages achieved according to the present invention.

Ezumi, et al. discloses a method of manufacturing a structural body using a friction stir welding method, the method including the steps of starting a friction stir welding by inserting respective rotary tools into plural welding joints at a first

position; stopping the friction stir welding of one welded joint by withdrawing one of the rotary tools from that welding joint, while continuing movement of the one of the rotary tools accompanying movement of the other of the rotary tools at a second position; stopping the movement of the respective rotary tools and stopping the friction stir welding while withdrawing the other of the rotary tools from its welding joint; inserting the respective rotary tools to a predetermined depth into each respective welding joint; and starting the friction stir welding by again starting the movement of the respective rotary tools along their respective welding joints. See column 2, lines 18-33. Note also column 5, lines 39-46 and 50-52; the paragraph bridging columns 5 and 6; and column 6, lines 6-9, 15-21, 34-41 and 50-53. See also the sole full paragraph on page 2 of Applicants' specification.

It is respectfully submitted that Ezumi, et al. discloses a friction stir welding technique for welding a joint line that is a straight line. It is respectfully submitted that this patent does not disclose, nor would have suggested, problems arising in connection with friction stir welding wherein the joint line changes direction; and it is respectfully submitted that this reference would have neither disclosed nor would have suggested the solution to such problem including retreating the rotary tool when the rotary tool moving along the joint line reaches a position where the direction of the joint line changes, so that the rotary tool is withdrawn from the joint line; changing the direction of the rotary tool or the members being welded; reinserting the rotary tool to the members being welded substantially at the position where the rotary tool was retreated; and moving the rotary tool along the joint line in the changed direction of the joint line.

The discussion by the Examiner on pages 3-5 of the Office Action mailed

February 24, 2003, with respect to the disclosure of Ezumi, et al., is noted. As can be seen, however, in Fig. 4 and Fig. 5 of this patent, the joint lines are straight lines. Ezumi, et al. does not teach, nor would have suggested, friction stir welding as in the present invention including wherein the friction stir welding is performed along a joint line whose direction changes, as discussed previously, or problems arising in connection therewith; and avoiding such problems by retreating the rotary tool at the position where the direction of the joint line changes, so that the rotary tool is withdrawn from the joint line, changing the direction of the rotary tool or the members being welded, and reinserting the rotary tool to the members being welded substantially at the position where the rotary tool was retreated, with the rotary tool moving along the joint line in the changed direction of the joint line, avoiding, for example, defects in the weld along the joint line that changes direction.

It is respectfully submitted that the additional teachings of Thomas, et al. would not have rectified the deficiencies of Ezumi, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art. Thomas, et al. discloses friction welding, for joining two workpieces or for operating on a workpiece, e.g., to repair a crack or join a member to a workpiece. In a second aspect described in this patent, for joining workpieces defining a joint region therebetween, a probe of material harder than the workpiece material is caused to enter the joint region and opposed portions of the workpiece on either side of the joint region while causing relative cyclic movement between the probe and the workpieces, whereby friction heat is generated to cause the opposed portions to take up a plasticized condition; the probe is removed; and the plasticized portions are allowed to solidify and join the workpieces together. Note the

paragraph bridging columns 1 and 2 of this patent.

Even assuming, arguendo, that the teachings of Thomas, et al. were properly combinable with the teachings of Ezumi, et al., such combined teachings would have neither disclosed nor would have suggested the presently claimed subject matter, including the friction stir welding along the joint line which has a change of direction, and wherein the friction stir welding method includes retreating the rotary tool from the first and second members being welded, when the rotary tool moving along the joint line reaches a position where the direction of the joint line changes, changing the direction of the rotary tool or the members, reinserting the rotary tool to the members being welded substantially at the position where the rotary tool is retreated, and moving the rotary tool along the joint line in the changed direction of the joint line, or other aspects of the present invention as discussed previously.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently in the application is respectfully requested.

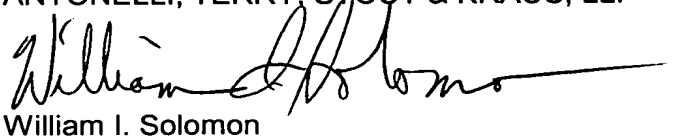
Attached hereto is a marked-up version of the changes made to the claims by the current Amendment. The changes are shown in the attachment captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADEVERSION WITH MARKINGS TO SHOW CHANGES MADE".

To the extent necessary, Applicants petition for an extension of time under 37 CFR § 1.136. Please charge any shortage in fees due in connection with the filing

of this paper, including extension of time fees, to the Deposit Account No. 01-2135 (Case No. 648.41112X00) and please credit any excess fees to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Please cancel claim 9 without prejudice or disclaimer, and amend the claims remaining in the application as follows:

1. (Amended) A friction stir welding method comprising:

conducting friction stir welding of at least first and second members, the at least first and second members forming a joint line, the friction stir welding being performed using a rotary tool along the joint line;

retreating [a] said rotary tool from said at least first and second members being welded, when said rotary tool, moving along [a] the joint line, reaches a position where the direction of the joint line changes, so that the rotary tool is withdrawn from the joint line;

changing the direction of said rotary tool or said members being welded;

reinserting said rotary tool to said members being welded substantially at the position where said rotary tool was retreated; and

moving said rotary tool along [a new] the joint line in the changed direction of the joint line.

2. (Amended) A friction stir welding method according to claim 1, wherein said direction of said rotary tool is changed by retreating said tool and then rotating a device that supports said rotary tool, thereby varying the tilt angle of said rotary tool against the direction of movement thereof.

7. (Amended) A friction stir welding method according to claim 5, further comprising:

upon reinsertion, inserting the rotary tool to a depth deeper than the insertion depth of said rotary tool before being retreated; and

after reinsertion, gradually reducing the insertion depth after starting the movement of said rotary tool.